Predictions of the Effect of Oceanic Density Fluctuations on the Earth's Time-Varying Gravitational Field

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The horizontal redistribution of mass within the oceans, driven by fluctuations in atmospheric pressure and winds, will cause time-dependent perturbations of the Earth's gravitational field. The oceanic response 10 atmospheric pressure changes at periods long enough to be resolved in space-gcmktic gravitational field measurements (that is, longer than about 1 month) is commonly believed to be inverted barometer, in which case it can be included directly in the estimated effects of atmospheric pressure fluctuations by simply averaging the contribution of atmospheric pressure over the oceans. The effect on the Earth's gravitational field of the wind-driven oceanic mass redistribution is estimated here from the products of a general circulation model of the oceans.

in a preliminary study of the influence of nontidal ocean processes on the Earth's gravitational field, a version of the Miami isopycnal-coordinate global ocean general circulation model (OGCM) adapted by D. Hu at the Joint Institute for Studies of the Atmosphere and Ocean was run at JPL, using forcing by observed winds determined from the National Centers for Environmental Prediction (NCEP; formerly the National Meteorological Center) operational analysis. This OGCM has a free surface, 11 vertical layers plus a mixed layer, realistic bottom topography, and a 2 degree longitude by 1 degree latitude grid spanning 80° S to 80° N latitude. The model was run in spinup mode for 10 years with climatological air-sea fluxes followed by a simulation spanning 1992-1994 with daily wind and heat flux from the NCEP operational analysis and sea surface salinity restoring to Levitus climatology. The ocean-bottom pressure at each grid point was computed and saved at 3-day intervals, from which the predicted effect on the Earth's gravitational field was computed. Comparisons between these predictions and Lageos-measured gravitational field changes (from which atmospheric effects have been removed) will be shown.